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FINAL REPORT

EXPANDED SOUTHERN PINE BEETLE PROGRAM

AN EVALUATION OF THE CUT-AND-LEAVE AND CUT-AND-TOP TACTICS FOR SOUTHERN PINE BEETLE SUPPRESSION:

I. SPOT BREAKOUT AND PROLIFERATION - NORTH CAROLINA

by

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II. WITHIN TREE SOUTHERN PINE BEETLE POPULATIONS - LOUISIANA

by

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The objectives of this evaluation were (1) by using spot growth, spot breakout, and proliferations, compare southern pine beetle-caused tree mortality around cut-and-leave, cut-and-top, and untreated spots, and (2) compare within-tree southern pine beetle populations in cut-and-leave, cut-and-top, and standing loblolly pines.

On the coastal plain of North Carolina in the winter of 1975-76 and in the Piedmont of North Carolina in the summer of 1976, treatments were applied to active southern pine beetle spots. Ten triplicates were selected in the winter and seven triplicates selected in the summer. Each triplicate chosen was based on similarity in forest type, basal area, and numbers of infested pines. The treatments (cut-and-leave, cut-and-top, or no treatment) were assigned at random within the triplicate. There were no significant differences among any of the treatments based on proliferations and spot growth (compared with breakouts). In the winter, one untreated spot grew in size and one cut-and-top spot had one proliferation within a quarter mile. In the summer, one untreated spot grew in size and one each of the other treatments broke out. No proliferations occurred in the summer.

From November 1975 to September 30, 1976, seven active southern pine beetle spots were used in Rapides and Grant Parishes, Louisiana to evaluate within-tree southern pine beetle population effects of the cut-and-leave and cut-and-top treatments. In each spot, at least three loblolly pines were selected for each treatment (including untreated standing pines). All infested pines felled were exposed to full sunlight. On all trees, two 100 cm^2 bark samples were taken on the tree bole at 1.4 m intervals from dbh to the top of the infestation; these comprised the first sample. The last sample was taken just prior to brood adult emergence and differed from the first sample in that four bark samples per interval were taken from the felled trees. All other techniques followed those developed at Texas A&M. Topological estimates were derived and those data subjected to an analysis of variance. The treatments failed to be different.

INTRODUCTION

The southern pine beetle, Dendroctonus frontalis Zimmerman, continues to kill trees in thirteen southern states. At the height of the outbreak, more than 78 million acres of host type were within the outbreak area. This is more than half the pineland in the South. Records show that 717 million board feet of beetle-killed sawtimber and 166 million cubic feet of pulpwood were salvaged (dead uninfested, infested red tops, infested green tops, and uninfested buffer strip trees) since 1971. We estimate that from one-third to one-half of the beetle-affected timber was salvaged. During this period of time, over 12 million dollars have been spent on southern pine beetle suppression programs by State and Federal agencies. In the South, three suppression methods are currently recommended by the U.S. Forest Service and include: (1) salvage removal of insect-infested trees, (2) pile-and-burn infested trees, and (3) chemical treatment of infested trees.

Salvage removal of infested pines is the most widely used suppression method. Not only are beetles moved from the woods in infested trees, but one is able to recover some of the losses that would have occurred if those trees were left in the woods. There are, however, some problems with attempting prompt salvage. Many times inclement weather conditions, administrative delay with sales, low volumes, inaccessibility, or poor timber market can severely limit a salvage-removal program.

Cut-and-spray and pile-and-burn while still used offer potential environmental hazards. They are also very costly to apply and may be more detrimental to southern pine beetle parasites and predators than to the beetle. What is needed are ways to control the southern pine beetle that are economical, more lasting, and less harmful to the environment.

With these biological and environmental dangers (both inherent and imagined) of cut-and-spray and pile-and-burn in mind, the cut-and-leave and cut-and-top tactics were considered. It was hypothesized that beetle population survival would be reduced, natural aggregation behavior disrupted, dispersal promoted, and subsequent tree mortality reduced.

Prior to this study, a great deal of discussion and debate centered around the use of cut-and-leave as a reimbursable tactic in southern pine beetle suppression projects. Texas Forest Service analysis of their 1973 operational data indicated some promise for the cut-and-leave tactic (Billings 1974). In this and additional evaluations in Texas, fewer proliferations occurred around active spots treated with cut-and-leave and salvage than around untreated active spots. In Virginia, it was found that summer applications reduced beetle broods (50 to 90 percent) and prevented spot spread. Winter treatments did not reduce broods, but did seem to disrupt spot proliferation. However, debates continued because of the lack of an experimental design in reaching these conclusions.

Agencies using cut-and-leave and cut-and-top tactics recommend that all beetle-infested trees be felled into the center of the spot and a buffer strip (equal to the average height of the pines in the stand) of green pines around the active head of the spot be felled in the same direction (Anonymous 1975).

The rationale underlying cut-and-leave and cut-and-top method is twofold:

(1) to reduce beetle populations in the trees by affecting the physical environment (temperature; phloem moisture), and

(2) disrupt the growth of the treated spot by causing any emerging beetles to disperse.

The role of phloem moisture content has been demonstrated by many authors (Clark and Osgood, 1964 a., b.; Gaumer and Gara, 1968; Hodges and Thatcher, 1976; Palmer, 1975; and Webb, 1977). Gaumer (1967) found that southern pine beetle survival was affected when phloem moisture was above or below an optimum level. Webb (1977) showed survival of larvae in bolts to be inversely related to phloem moisture. In the field, trees with high phloem moisture had a lower beetle ratio of increase than trees with lower moisture. By removing the crowns in the winter (cut-and-top), it is suspected that moisture levels will remain above optimum levels for brood survival. In a recent study conducted in Louisiana, the December and January differences in moisture content between cut-and-top and check trees

was minimal. It is also possible that trees felled during the winter will lie in standing water, which might have some impact on beetle survival (Hetrick, 1949). Excessive temperatures may also have some influence on beetle survival (Beal, 1933; Palmer, 1975).

The cut-and-leave method is adapted to impose some of these adverse micro-environmental effects on the beetle population. By leaving the felled trees' crowns intact, the trees should dessicate faster than the standing infested trees do. The horizontal position exposes the top portion of the stem to more direct solar heating, which might reach a lethal level. However, when the phloem on the upper portion of felled trees reached 55° C. in Texas during the summer, only a slight reduction in beetle survival followed (Palmer, 1975). In Louisiana, brood survival was very low for beetles developing on the exposed side of infested trees in the summer, fall, and winter (Hodges and Thatcher, 1976). Ips beetles and sawyers may better utilize the downed timber, especially if the felled pines contained just recently attacking southern pine beetles. In this event, the Ips and sawyers should offer competition to the southern pine beetle.

The effect of brood stage and felling was investigated by Hodges and Thatcher (1976) and Ollieu (1969). Hodges and Thatcher found no difference in survival between early brood and late brood trees felled at the same time. However, late broods had smaller brood reductions than early brood trees in Texas (Ollieu, 1969).

Probably more important than the alteration of the physical environment in the use of the cut-and-leave and cut-and-top tactics is the disruption of spot expansion. The felling of the green buffer strip insures that the secondary attractant-response mechanism is disrupted. Beetles which survive and emerge from these felled trees will tend to disperse in the absence of aggregating pheromones (Gara, 1967). If this dispersal does occur, it will subject the beetle population to additional mortality.

If the felling is done in the summer when major spot expansion is occurring, the physiological conditions of the beetles are such that long range dispersal may not be possible (Hedden, personal communication.)

When attempting to evaluate any new or old control tactic, it is necessary to measure as many variables as possible so one can state reasons for success or failure. In the case of SPB suppression tactics, one can assume that if all infested trees are removed from the woods, treated with insecticides, or piled and burned, the beetle population will be adversely affected. This would hold true at least in and around the treated spot. However, with cut-and-leave and cut-and-top, infested material is left in the woods. This complicates the evaluation of a tactic when attempting to relate beetle numbers to additional tree mortality.

OBJECTIVES

The objectives of this study were (1) to evaluate cut-and-leave and cut-and-top as tactics to disrupt spot growth and proliferation and (2) to determine the survival of southern pine beetles in standing, cut-and-top, and cut-and-leave trees.

METHODS

I. Spot Breakout and Proliferation - North Carolina

The evaluation of the cut-and-leave and cut-and-top tactics took place on the Coastal Plain and Piedmont areas of North Carolina from September 20, 1975 to September 28, 1976.

The detection of spots was made by the North Carolina Division of Forest Resources. Ground checks were made by State and Private Forestry technicians (two) and North Carolina Forest Service personnel. When a spot was determined to be active, State and Private Forestry technicians would meet with the landowner in an attempt to get his permission to use the cut-and-leave or cut-and-top techniques.

If permission was granted, specific data were collected on each spot (Appendix I). These data sets included numbers of active trees, tree species, average dbh, basal area, age and forest type of the residual forest. All designated trees were marked prior to cutting (Fig. 1a). After a group of nine spots were selected, they were grouped into sets of three. The sets were

a

b

Figure 1. Active SPB spot (a) prior to and (b) after cut-and-leave tactic applied.

made of the stands which, based on the initial data collected (Appendix I), best resembled each other. For each set, the treatment (cut-and-leave, cut-and-top, or untreated check) was assigned at random.

State and Private Forestry technicians then obtained bark beetle control crews from the North Carolina Division of Forest Resources Districts and Army Corps of Engineers to conduct the treatment. Texas Forest Service cut-and-leave and cut-and-top recommendations were followed (Appendix II) (Fig. 1b). The State and Private Forestry technician supervised the complete treatment of each spot and kept records on time, cost, and volumes of trees cut. Each month after treatment during the summer months, and the following spring after the winter treatments, the spots were checked for breakouts. Each spot that was not treated (untreated check) was checked every 2 weeks for additional attacked trees. These new infested trees were added to the treatment report forms (Appendix II

In June and December of 1976. all spots were photographed using color infared film at a scale of 1:6000. Any proliferation within one-quarter mile of each spot was recorded.

The following numbers of spots were used in this evaluation:

	WINTER (Oct. 1 to Apr. 30)	SUMMER (May 1 to Sep. 30)
CONTROL	16	17
CUT-AND-LEAVE	16	8
CUT-AND-TOP	10	7

For the purpose of statistical analysis, the winter treatments included 10 triplicates and the summer treatments seven triplicates. These data were subject to the Cochran Q Test (Cochran, 1950). We tested whether the differences in additional trees infested or spot proliferations were influenced by the treatments. The null hypothesis being whether the probability of response (additional trees attacked at the spot periphery's new spots within a quarter-mile of the treatment spot) is the same for all treatments. The null hypothesis will be rejected if the values of Q are so large that the probability associated with their occurrence is equal to or less than $\alpha = .01$.

II. Within Tree Southern Pine Beetle Populations - Louisiana

Because of the lack of manpower, time, and beetles in North Carolina, it was decided to evaluate the effects of cut-and-leave and cut-and-top on within tree beetle populations in Louisiana. The Catahoula and Evangeline Ranger Districts

located in Grant and Rapides Parish, respectively, were selected as the study areas.

In Louisiana, spot treatment began on November 1, 1975, and ended September 10, 1976. In all, seven separate spots were located and treated. A summary of the tree numbers and brood stage for each spot is presented in Table 1. In all cases, the cut-and-leave and cut-and-top trees were felled and exposed to full sunlight (Fig. 2). The standing study trees were shaded on all sides and none of the residual vegetation was removed from around them. All trees were loblolly pines and ranged in diameter from 14.2 to 47.0 cm for the untreated trees, 13.0 to 40.6 cm for the cut-and-leave trees, and 14.7 to 48.5 cm for the cut-and-top trees.

The techniques and equipment used for taking the 100 cm^2 bark samples were developed by Coulson, et al. (1975), except that only two samples were taken at each sampling interval. The first bark sample on infested trees was taken on treatment day 1 from all the trees in that spot. The first sample interval on the tree was at 1.4 m, with the remainder at approximately every 1.4 m to the top of the infestation. Two samples per interval (north and south) were taken on each treated and untreated tree. The same two samples/ht were taken on each standing tree at the last sampling period. However, four samples were taken for the last

TABLE 1. Southern pine beetle brood stage and average loblolly pine diameters in the Louisiana within tree population effects of cut-and-top and cut-and-leave.

Plot No.	Date Treatment Applied	Treatment: Untreated				Cut-and-top				Cut-and-leave			
		PA	L	P	BA	PA	L	P	BA	PA	L	P	BA
1	Nov. '75												
		X				X				X			
		X	X			X	X			X			
		X	X			X	X			X			
		X	X			X	X			X	X		
		X	X	X		X	X			X	X		
		X	X	X			X			X	X		
			X	X			X				X	X	X
							X	X					
$\bar{x}$ tree dia.(cm)±s			29.2 ± 6.6				24.1 ± 3.8				26.2 ± 7.6		
2	Mar. 3 '76	X	X	X	X	X	X	X	X		X	X	
		X	X	X	X	X	X	X	X		X	X	
			X	X	X		X	X	X		X	X	X
$\bar{x}$ dia.			41.2 ± 4.3				40.0 ± 9.5				22.6 ± 15.7		
3	June 15	X				X				X			
		X				X				X			
		X				X				X			
$\bar{x}$ dia.			22.4 ± 5.1				18.1 ± 2.9				17.8 ± 3.1		
4	June 29	X				X				X			
		X				X	X			X			
		X				X	X			X	X		
$\bar{x}$ dia.			29.0 ± 6.9				25.2 ± 3.1				25.9 ± 5.1		
5	July 29	X	X	X	X		X	X	X		X	X	
			X	X	X		X	X	X		X	X	X
			X	X	X		X	X	X		X	X	X
$\bar{x}$ dia.			20.5 ± 1.2				16.8 ± 2.2				13.8 ± 1.4		
6	Aug. 3	X	X	X		X	X	X		X	X	X	
			X	X	X	X	X	X		X	X	X	X
			X	X	X	X	X	X			X	X	X
$\bar{x}$ dia.			16.9 ± 2.6				17.5 ± 2.1				18.0 ± 1.8		
7	Sep. 30	X	X			X	X			X	X		
		X	X	X		X	X			X	X		
		X	X	X			X	X	X	X	X		
			X	X			X	X	X		X	X	X
			X	X	X		X	X	X		X	X	X
			X	X	X		X	X	X		X	X	X
$\bar{x}$ dia.			36.1 ± 10.0				28.5 ± 6.7				27.2 ± 5.3		

Figure 2. Example of area used for within tree SPB population sampling. Untreated standing pines are located off to the left.

sample at each sampling interval from the cut-and-leave and cut-and-top trees. The samples were top, bottom, and both sides. The last sample was taken just prior to beetle emergence and put into rearing cups in the laboratory. All samples in rearing were held for 30 days.

The standard tree data (Coulson, et al. 1975) was recorded (Appendix IV) and Coulson's data collection forms modified (Appendix V). All data was subject to the topological mapping procedure developed at Texas A&M (Coulson, et al., 1976; Pulley, et al., 1976). This statistical procedure estimates the total number of insects inhabiting a tree trunk.

A two-way analysis of variance was used to test plots, treatments, and their interaction. Because there was no significant interaction, the within cell interaction was pooled and the analysis was treated as a randomized complete block design (plots = blocks). The Duncan's Multiple Range Test was used to determine if pairs of plots were significantly different from each other.

Because of the high within-cell variation, a non-parametric test, Friedman's Two Way Analysis of Variance was used. In this test the mean of each treatment is ranked across plots. The hypothesis tested is that the average ranking for any particular treatment is 2.

The ratio used in the analyses was based on the maximum numbers of beetles in all stages in the first sample compared with brood adults in the last sample (i.e., November '75 plot; untreated; Tree 77; first sample: parent adult PA = 7.4, larvae L = 0.0, pupae P = 0.0; second sample: brood adult BA = 15.26 Ratio = 2.05). The average density used is the number of beetles/dm^2.

RESULTS

I. Spot Breakout and Proliferation - North Carolina

There were no significant differences among treatments in the North Carolina evaluation (Table 2). The fact that so few untreated spots grew in size prevented a satisfactory evaluation. The untreated spots had from 5 to 25 active trees and only the two largest spots (i.e., 18 and 25 trees) grew in size. None of the treatment spots broke out in the winter evaluation and only two broke out in the summer evaluation (Table 2).

As expected, the volumes in the buffer strip trees and in the infested tree varied a great deal from spot to spot (Table 3). A zero in the volume range indicates that all the infested volume was below merchantable size. As much as 1,159 cubic feet were cut in the infested trees and 1,598 cubic feet in the buffer strip.

Table 2. Breakouts, proliferations, and spot growth around cut-and-top, cut-and-leave, and untreated areas in North Carolina.

Season	Treatment	No.	Percent breakouts	Percent proliferations	Percent spot growth
Winter	untreated	10	-	10.0	10.0
	cut-and-top	10	0.0	10.0	-
	cut-and-leave	10	0.0	0.0	-
Summer	untreated	7	-	0.0	14.3
	cut-and-top	7	14.3	0.0	-
	cut-and-leave	7	14.3	0.0	-

Table 3. Numbers of spots, infested trees, basal areas, volumes, and costs in 1975-1976 North Carolina cut-and-leave and cut-and-top evaluations.

	No. Spots	Avg. No. infested trees	Avg. basal area	Avg. Cu. Ft.		Costs	
				Infested	Buffer	A[1/]	B[2/]
WINTER							
Untreated	16	8 ± 5[3/] (5-25)	122±20 (90-160)	72±48 (0-205)	-	-	-
Cut-and-leave	16	10±5 (5-17)	110±10 (90-120)	99±88 (0-319)	312±257 (120-968)	8.63±4.54 (4.50-21.45)	63.67±44.87 (25.00-183.75)
Cut-and-top	10	10±6 (5-26)	128±25 (100-170)	147±255 (0-862)	597±464 (25-1598)	5.65±1.48 (3.95-9.25)	57.67±23.86 (23.40-93.60)
SUMMER							
Untreated	17	8±4 (4-18)	96±31 (50-180)	171±265 (24-1159)	-	-	-
Cut-and-leave	8	13±14 (5-47)	124±35 (90-200)	164±94 (98-333)	296±88 (127-416)	4.94±0.90 (3.00-6.00)	55.68±19.51 (36.00-97.00)
Cut-and-top	7	8±4 (5-15)	118±21 (90-150)	82±40 (30-146)	159±136 (9-174)	4.25±0.52 (3.50-5.00)	33.86±12.38 (9.63-40.50)

1/ Vehicle mileage, chain saw gas and oil.

2/ Labor to treat spots

3/ Average ± standard deviations.
(range)

The cost of felling the infested trees ranged from \$3.95 to \$21.45 for vehicle mileage, chainsaw gas, and chainsaw oil. Labor to treat spots ranged from \$9.63 to \$183.75 (Table 3). The high costs reflect problems with crews and breakdowns of equipment.

II. Within-Tree Southern Pine Beetle Populations - Louisiana

Differences in the ratios of brood adults to total brood for individual sampling dates were not significant. This was based on the randomized complete block analysis of variance and Friedman's two-way analysis of variance. The ratio (1.03/dm^2) was greatest for all treatments combined in June and the lowest (0.19/dm^2) in August (Table 4). The total analysis is somewhat misleading because different brood stages were present during the different sampling periods. Further analysis will be done in reference to brood stage and submitted as an addendum to this report.

The ratio of brood adults to total brood for all treatments combined was lowest for the cut-and-top (0.36) and highest for the untreated plots (0.73). Cut-and-leave had a ratio of 0.58 (Table 4).

For all samples combined, the highest average number per dm^2 for all brood stages in sample 1 was 133. This was recorded on a cut-and-leave tree in the August plots (plot 6 Table 1).

Table 4. Ratio of brood adults in last sample to total brood in first sample in untreated, cut-and-leave, and cut-and-top loblolly pines in Rapides and Grant Parishes, LA. 1975-76.

	Month							
Treatment	8 Nov 75	3 Mar 76	15 June 76	29 June 76	29 July 76	3 Aug 76	30 Sep 76	TOTAL
Untreated	1.24	0.72	0.46	1.29	0.32	0.33	0.41	0.73
Cut-and-leave	0.78	1.84	0.04	0.86	0.12	0.14	0.32	0.58
Cut-and-top	0.27	0.35	0.10	0.93	0.36	0.08	0.45	0.35
TOTAL	0.74 ab	0.97a	0.20b	1.03a	0.27b	0.18b	0.39ab	0.56

The highest average number of brood adults/dm^2 in sample 2 was 21.6 from an untreated tree in plot 7 (September 1976).

DISCUSSION

The cut-and-leave and cut-and-top evaluation in North Carolina determined that under those specific conditions, treatments were not necessary or effective. Two factors might be responsible.

The first deals with the apparent collapse of southern pine beetle populations in eastern North Carolina. This was reflected in the reduction in total numbers of spots detected by the North Carolina Forest Service from 1974 to 1975. A total of 300 spots were visited during this evaluation and of those, 100 were active.

Most (85 percent of the spots visited) had less than 10 actively infested trees. This being the case, one would expect a high proportion to go inactive. This would support unpublished data provided by the Texas Forest Service (TFS). This also supports TFS's recommendations that small spots need not be detected or treated.

The largest problem in applying the cut-and-leave and cut-and-top treatments to SPB spots was the unwillingness of the landowners to allow the correct width of buffer strip to be cut. Even on the large public ownership areas, much pressure was exerted by the managers to keep the buffer strip as small as possible. Most owners were very reluctant to sacrifice buffer areas that in many cases were as large as the infested spots.

Landowners also had an alternative to the cut-and-leave, and cut-and-top evaluation in cut-and-spray program which the North Carolina Forest Service currently offers in the treatment of small SPB spots. It was difficult to convince cooperators that the work was designed to determine the benefit to be gained by using cutting prescriptions in place of cut-and-spray. Many private landowners were unwilling to allow an unproven procedure to be applied to their spots when the NCFS program was available to them. The cut-and-spray technique was especially attractive because no buffer strip of green trees was necessary. The necessity of cutting the large number of green trees definitely limited the areas in which we could work.

Of minor importance were problems with the cutting crews who applied the treatments. It was difficult and time consuming to buck a tree which had fallen the wrong way and carry the sections into the center of the spot. Spot treatment often proved difficult due to slope and other geographical features, as well as the crown characteristics of the trees, and it was often impossible to fell trees inside of the spot.

At times, determining tree activity at dbh was impossible. Several times pitch tubes were evident on the bole of the tree, but above dbh. In these instances, we usually tried to reach the areas where the tubes were evident and determine activity at these points, rather than at dbh as specified in the instructions.

Acceptance of the treatment by small private landowners was very poor. The landowners are not willing to have the necessary green uninfested trees cut. They would prefer the cut-and-spray technique where only infested trees are removed. Even if the cut-and-spray program is discontinued, we doubt if cut-and-leave, cut-and-top will be widely used. We believe that landowners would rather fell the infested trees and burn them than use cutting prescriptions that involve large buffer strips. There are some indications that by taking the buffer strip around small spots, more timber would be lost than if the spot were left untreated.

We found that the cut-and-leave and cut-and-top treatments did affect within-tree southern pine beetle populations. This does not support the findings of Hodges and Thatcher (1976). However, the studies were done in different years and used different experimental designs.

Cut-and-leave or cut-and-top could still be effective approaches under certain conditions, even if beetle populations were not adversely affected. If in fact these treatments make beetles disperse when they are not physiologically prepared, the treatments could be very effective.

At present, cut-and-leave is recommended for use in Texas, Tennessee, and Virginia. Texas by far treats the largest numbers of active spots, accounting for about 50 percent of all the spots treated in 1975. The Texas Forest Service recommends cut-and-leave on small spots containing 10 to 50 infested pines. The

Virginia Forest Service recommends cut-and-leave on small spots ($<$ 20 infested trees) throughout the year. The Tennessee Division of Forestry has recommended cut-and-leave on small spots ($<$ 26 active trees) since early 1975. The practice has not gained favor in Tennessee even with poor or non-existent pulpwood markets. On State forests and pulp and paper company lands in Tennessee, spray crews still handle treatments when salvage can not be practiced.

We currently lack the technology, methodology, and funding to detect and treat all the active spots in a given area, nor do we know what percentage of active spots must be treated to cause a significant reduction in beetle populations with a resulting reduction in tree mortality.

There, however, is still a need for a tactic such as cut-and-leave. A simple, environmentally safe technique such as cut-and-leave would provide an alternative control method in sensitive areas, such as State Parks, watersheds, or inaccessible areas.

Program Supported Activities

1. Publications - none

2. Meetings - First Annual Expanded Southern Pine Beetle Meeting, New Orleans, November 1, 1975.

   Data Management Group - Texas A&M, College Station, April 6 and 7, 1976.

3. Personnel

   a. Supported with program funds -

      (1) Tom Perry, Biological Technician, Rocky Mount, N.C.

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   b. Not supported by program - Co-authors other than (1) and (2) above.

4. Presentations - none

5. Cooperation with others:

   a. Coulson's group at Texas A&M

6. Cooperators -

   a. Kisatchie National Forest

      Evangeline Ranger District - Fred Locke

      Catahoula Ranger District - Doug Williams

   b. North Carolina Division of Forest Resources

   c. Duke University, School of Forestry

   d. Corps of Engineers - Mike Large

   e. Private landowners in North Carolina

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PRELIMINARY GROUND CHECK REPORT

INSTRUCTIONS:

1. Causal agent must be SPB, otherwise go to another spot.
2. Chip away just enough bark on trees to determine if the spot has active beetles in it.
3. The study calls for 5-25 actively infested trees. If there are less than five such trees, go to another spot. Keep check on this spot just in case it does increase in size and thus lend itself for this study.
4. If there are at least five actively infested trees, assign the spot a number and proceed to fill out the Preliminary Ground Check Report.
5. Estimate the number of actively infested trees--based on checking a few--and mark them with tree paint. Estimate the average DBH and average total height of these trees, and also record the tree species. Make a prism sample within that area of actively infested trees and record.
6. Select three of the dominant or codominant trees in that group of actively infested trees. Take two increment cores from opposite sides of each tree--one where the crown is fullest, and one where the crown is thinnest. One core from each tree should be long enough so that the age of each tree can be determined in the laboratory. The second core should be long enough so that ten annual increments can be measured also in the laboratory. Each core should be placed in a separate plastic or paper straw to prevent breakage. The cores from each tree (now in separate straws) should be kept together and labelled with your name, date, and spot number. Try to select active trees that still have cambium intact. The cones should be refrigerated.
7. Record the specified data for each of the four quadrants--NW, NE, SE, SW-- around the beetle spot.
8. The preliminary work for this spot is finished. Move on to another spot

SPOT DETECTION AND LABORATORY FORM

Name: ____________________

Date: ____________________

Spot size from the air: ________________ Spot Number: ____________

Location

Block	Block	Point

Timbertype within 1 mile of spot

NW	NE	SW	SE

1= pine 2= pine-hardwood 3= hardwood 4= other

Growth Data

Last 5 years	6-10 years

PRELIMINARY GROUND CHECK REPORT

Name: ______________

Date Checked: ________

Spot Number: ________

SPB Spot Data					
# Actively Infested trees	Tree Species	Average DBH*	Average Total Height**	Basal Area	Average Age (3 trees, 2 cores each)

Tree species: 1= loblolly
2= shortleaf
3=virginia
4= long leaf
5= other (specify)

* Two inch classes:
3-4"= 4
5-6"= 6
7-8"= 8
9-10"= 10
etc.

** Five-foot classes

Surrounding Stand Data				
	NW	NE	SE	SW
Type*				
DBH**				
Height***				
Basal Area				

* Type:
1= pine
2= pine-hardwood
3= hardwood
4= other (specify)

**DBH:
1= 1-3"
2= 4-12"
3= 12+

***Height: -
Ten-foot classes

Remarks:

APPENDIX II

Infestations of the southern pine beetle in East Texas can be treated by a method known as "cut-and-leave" to reduce losses from spot growth and proliferation. The Texas Forest Service recommends application of the cut-and-leave procedure in situations where prompt salvage or other control alternatives are not feasible. The method is designed to disrupt spot growth in small to medium-sized spots by dispersing attacking beetles. Also, survival of developing broods in felled trees may be reduced. The treatment is simple, inexpensive and requires a minimum of manpower, equipment and training.

HOW TO APPLY

1. *Identify the active trees within the spot.*
2. *Fall all active trees toward the center of the spot (Fig. 2).*
3. *Fall a horseshoe-shaped buffer of green, uninfested trees around the active head of the spot and leave them lying on the ground with crowns pointed toward the center of the spot. The buffer should be as wide as the average height of the trees in the spot (40' - 60' wide).*
4. *Old dead trees with no bark beetles remaining should be left standing to allow development of parasites and predators that help control beetle populations.*
5. *If possible, check the treated spot after two weeks for re-infestations (breakouts) around the periphery. Re-treat all breakouts.*

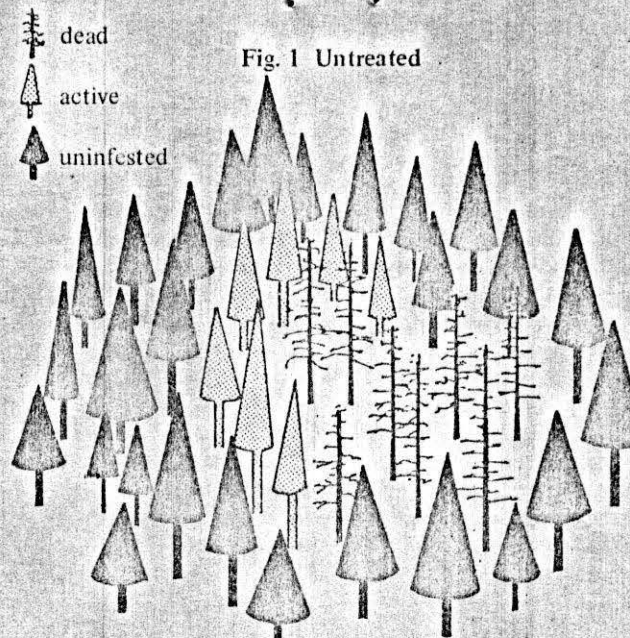

Fig. 1 Untreated

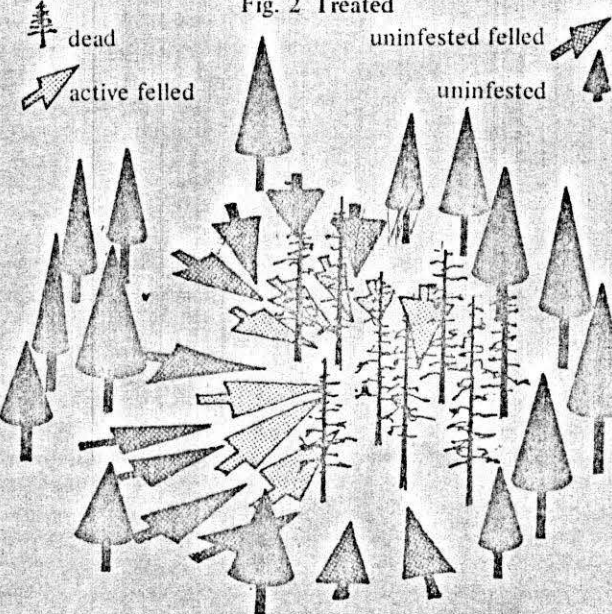

Fig. 2 Treated

The buffer strip of green trees must be included to assure effective control, particularly for spots treated in the spring and summer.

WHEN TO APPLY

Cut-and-leave treatment may be applied at any time of the year. However, the treatment appears most successful when applied during the summer months to spots with 10 - 50 active trees. Prompt treatment after detection is recommended because experience has shown that large spots (100 + active trees) are difficult to control regardless of the treatment applied. On the other hand, spots with less than 10 active trees often are soon abandoned by the beetles and require no treatment.

GLOSSARY OF TERMS

1. SOUTHERN PINE BEETLE . . . . <u>Dendroctonus frontalis</u> (Coleoptera; Scolytidae).
2. SPOT . . . . A group of dead or dying pine trees infested by the southern pine beetle.
3. SPOT GROWTH . . . . The natural expansion of untreated spots as additional green trees on the spot periphery become infested in sequence.
4. SPOT PROLIFERATION . . . . A new spot initiated by beetles escaping from controlled and/or uncontrolled spots, located at some distance from the immediate periphery of the initial spot.
5. SPOT BREAKOUT . . . . Infestation of green trees on the periphery of a spot following a control treatment.
6. ACTIVE HEAD OF SPOT . . . . That portion of the spot containing beetles in the process of attacking green trees.
7. ACTIVE TREE . . . . A pine tree containing bark beetle broods (eggs, larvae, or pupae) or attacking adults.
8. BUFFER . . . . A group of green, uninfested pines adjacent to the most recently infested trees in a spot. Both the buffer and the active trees are felled to assure disruption of spot growth and dispersion of beetle populations.

APPENDIX III

APPENDIX IV

APPENDIX V

$ TREE

Valid Entries

Data Type	(1) ______
Continuation No.	(2) ______
Geographic Area	(3) ______
Plot No.	(4) ______
Tree No.	(5) ______
Sample Year	(6) ______
Sample Julian Date	(7) ______
Total Tree Height	(8) ______
Height At Top of Infest.	(9) ______
Diameter At Top of Infest.	(10) ______
Height At Base of Infest.	(11) ______
Diameter At Base of Infest.	(12) ______
Diameter At Breast Height	(13) ______
Eng. E, Metric M	(14) ______
Tree Species	(15) ______
Diameter At Sample Height	(16) ______
	(17) ______
	(18) ______
	(19) ______
	(20) ______
	(21) ______
	(22) ______
	(23) ______
	(24) ______
	(25) ______
No. Heights Sampled	(26) ______
Bole Length	(27) ______
Basal Area	(28) ______

SO-4000-4

DATA LISTING FOR 80 COL. PUNCHED CARD

SOUTHERN FOREST EXPERIMENT STATION T-10210 FEDERAL BUILDING 701 LOYOLA AVENUE NEW ORLEANS, LOUISIANA 70113	STUDY	ENTERED BY	DATE	PUNCHED
	RESEARCHER	CHECKED BY	DATE	VERIFIE

LINE NUMBER	FIELD DESIGNATIONS				TREATMENT	DATE	YEAR	FIRST SAMPLE								LAST SAMPLE				
								PARENT ADULTS		LARVAE		PUPAE		BROOD ADULTS		BROOD ADULTS				
	PLOT	TREE #	SAMPLE HEIGHT	DIAMETER OUTSIDE BARK				Side a	Side b	a	b	a	b	a	b	Side a	Side b	Top	Bottom	
	1	2 3	4 5 6	7 8 9	10	11 12 13	14 15	16 17 18	19 20 21	22 23 24	25 26 27	28 29 30	31 32 33	34 35 36	37 38 39	40 41 42	43 44 45	46 47 48	49 50 51	52 53 54 55 56
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